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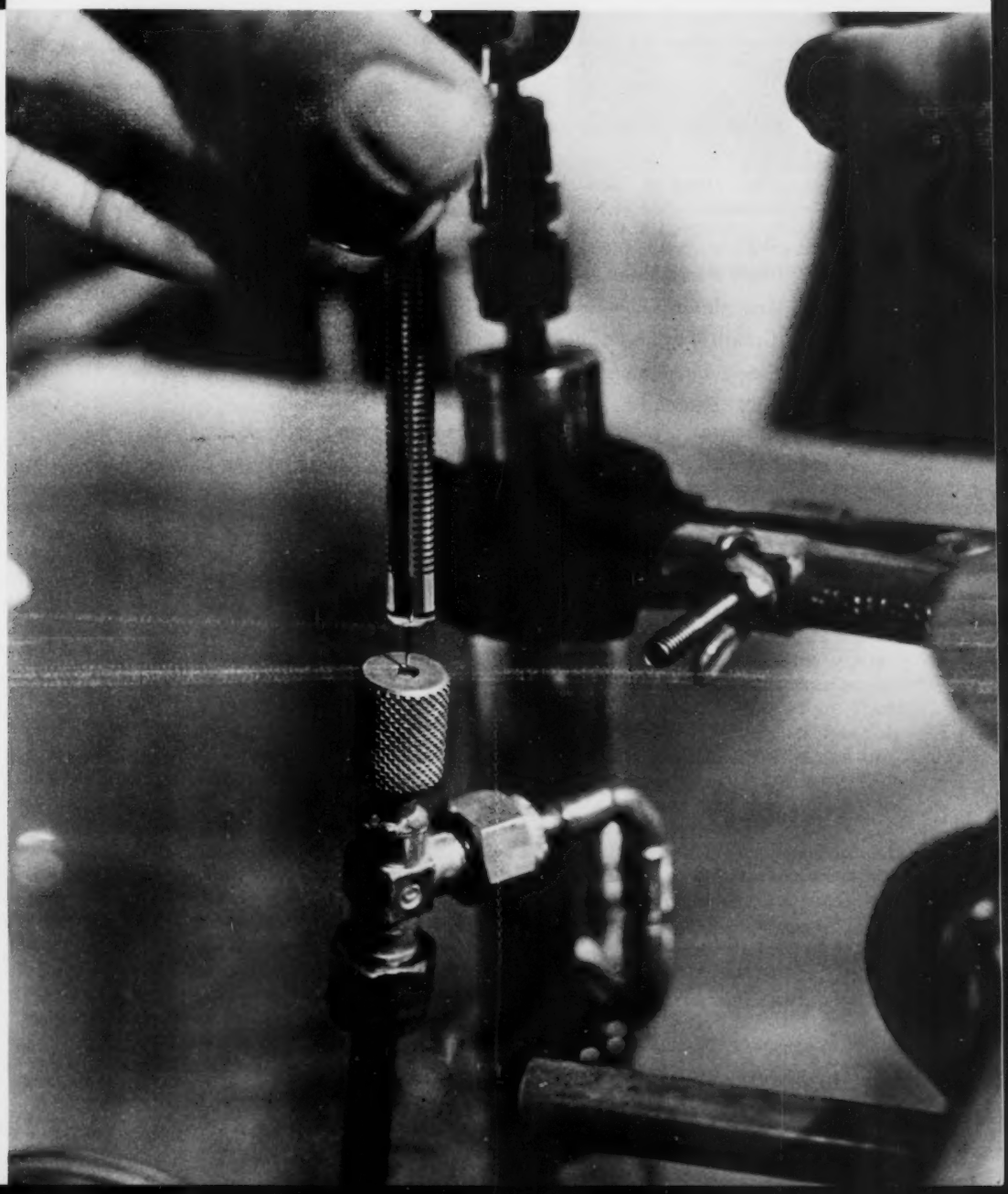
NATIONAL BUREAU OF STANDARDS

Technical News Bulletin



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U.S. DEPARTMENT OF COMMERCE
Maurice H. Stans, Secretary

NATIONAL BUREAU OF STANDARDS
L. M. Branscomb, Director

CONTENTS

COVER: *An important tool to help fight water pollution is a modified gas-liquid chromatographic analyzer. Here a hydrocarbon sample similar to the type found in polluted water is being injected into the analyzer.* *(See page 143.)*

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The National Bureau of Standards serves as a focal point in the Federal Government for assuring maximum application of the physical and engineering sciences to the advancement of technology in industry and commerce. For this purpose, the Bureau is organized as follows:

- The Institute for Basic Standards
- The Institute for Materials Research
- The Institute for Applied Technology
- Center for Radiation Research
- Center for Computer Sciences and Technology

The TECHNICAL NEWS BULLETIN is published to keep science and industry informed regarding the technical programs, accomplishments, and activities of NBS.

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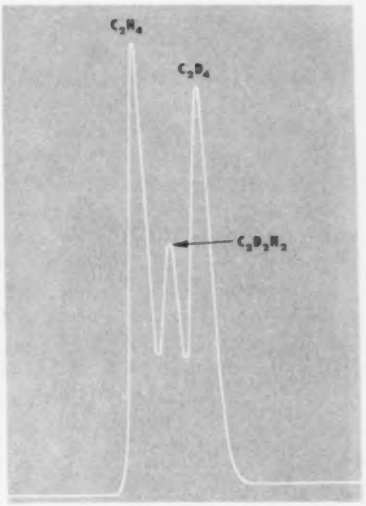
Stanley P. Wasik injects a hydrocarbon sample into the modified gas-liquid chromatographic analyzer as Wing Tsang makes notes on the recorder.



Ethylene, well separated from its deuterated products, illustrates the very good separation possible using the modified gas-liquid chromatographic technique.

GAS-WATER CHROMATOGRAPHY
AIDS WATER POLLUTION ANALYSIS

EXPERIMENTS at the Bureau showed that aqueous solutions of complexing metal ions may be used as the stationary phase in gas-liquid chromatography (GLC) columns. Metal ion solutions have been used for separating hydrocarbons by groups and for separating deuterated unsaturates from their lighter isomers. This is contrary to conventional GLC where the stationary phase is a non-volatile solution. The technique is being applied to the analysis of hydrocarbons present in water pollution.

Stanley P. Wasik and Wing Tsang of the NBS Institute for Materials Research developed [1] water-base GLC columns that are stable if the carrier gas is saturated with water vapor of the same partial pressure as the aqueous solution in the column.

The experimental apparatus included a helium gas source, a water-saturator, an analytical column, and a hydrogen flame detector. The water-saturator and the analytical column were immersed in a constant temperature bath.

The principle behind the separations is that certain metal ions such as Ag^+ and Hg^{2+} react with unsaturated hydrocarbons to form thermodynamically stable complexes, but do not react with saturated hydrocarbons. Thus it is possible to make separations based on specific chemical interactions, as opposed to conventional GLC separation based on volatility. The time required for an injected solute to be eluted from the column depends upon the stability constant of the metal ion-unsaturated complex. By a proper choice of complexing metal ions it is possible to design columns that are specific for different hydrocarbon groups (olefin, alkanes, and aromatics). Because the separation depends on chemical interaction there is a strong isotope effect. Thus these columns are very efficient for separating deuterated olefins and aromatics from their higher isomers.

Using this technique Drs. Wasik and Tsang were able to compute the stability constants for the reactions of unsaturates with Ag^+. The unsaturates studied were ethylene, propylene, isobutene, toluene, and benzene.

[1] For further details, see Wasik, S. P., and Tsang, W., Gas chromatographic determination of partition coefficients of some unsaturated hydrocarbons and their deuterated isomers in aqueous silver nitrate solutions, J. Phys. Chem. (in press).

Drs. Brauer, Huget, and Termini examine an EBA specimen that has been subjected to a compressive strength of 15 000 psi.

NBS DEVELOPS NEW FORMULATIONS FOR EBA DENTAL CEMENTS

SINCE THEIR INTRODUCTION THREE YEARS AGO, ethoxybenzoic acid cements, commonly called EBA cements in the dental profession, have proved superior to conventional cements. Researchers at the Bureau, developers of the putty-like EBA cements, now have increased the usefulness of this material. Through new formulations, the cement may become the preferred material for long-lasting temporary fillings and for pulp capping procedures. In its present applications as a crown and bridge cement and as a base under fillings, the cement is used in at least ten commercial products, the sales of which are estimated to be $300 000 annually.

The EBA cements are an outgrowth of studies at the Bureau to improve the conventional, zinc oxide eugenol (ZOE) cements. This program on the EBA cements is conducted within the NBS Dental Research Section by Drs. Gerhard M. Brauer, Eugene Huget,* a guest worker at NBS, and Dominic Termini with the support of the Dental Division of the U.S. Army Medical Research and Development Command.

Aluminum-Oxide-Reinforced Cements

During their earlier studies of ZOE cements, the NBS researchers found that an improved cement could be produced by reacting certain ring-forming compounds (chelating agents) with any of a number of metal oxides.[1] Later they found that the reaction products of zinc oxide and various additives, such as aluminum oxide and hydrogenated rosin, with EBA-eugenol liquid yielded a product with greatly enhanced physical properties.[2] This aluminum-oxide-reinforced EBA cement has compressive, shear, and tensile strengths three to four times that of commercial ZOE formulations and has a maximum compressive strength of 15 000 psi.

*Now with the U.S. Army Institute of Dental Research, Washington, D.C.

The cement was prepared by partially replacing the eugenol of the zinc-oxide-eugenol formulation with EBA. A powder consisting of 64 percent ZnO, 30 percent Al_2O_3, and 6 percent hydrogenated rosin was then mixed with this liquid in a powder-to-liquid ratio of 1.7 g per 0.2 cm^3. Significantly, with this formulation the product has a low film thickness (around 20 to 30 μm) and hardens in less than ten minutes, making it especially suitable as a crown and bridge cement.

On incorporating more powder into the mix, excellent insulating base materials for use under metallic fillings were obtained. These products also have physical properties superior to those of the ZOE cements. Especially desirable is their high ten-minute compressive strength, which can easily withstand the pressures encountered when an amalgam restoration is placed in a prepared cavity.

A sectioned tooth shows an amalgam restoration packed over an aluminum-oxide-reinforced EBA cement with a pressure of 2000 psi. As can be seen, the insulating base withstood the packing pressure.

Plastic-Reinforced Cements

Prior to plastic-reinforced EBA cements, the brittleness of the zinc oxide-eugenol-EBA cements had severely limited their usefulness as a temporary filling material, particularly in treating multiple surface caries in areas subject to heavy biting forces.

A long-term temporary restorative with improved tensile strength and stress-bearing characteristics was needed for treating dental restorative problems requiring extended periods of treatment or whenever final treatment must be delayed. Such occasions arise in teeth in highly decay-prone mouths, particularly those of children, where immediate removal of all caries is required. The Armed Forces also have unique dental requirements, such as emergencies at remote sites or in combat zones that preclude the insertion of permanent restorations.

Recent studies at NBS demonstrated that the tensile strengths of the conventional ZOE cements could be improved more than eight-fold by incorporating powdered acrylic polymers of relatively low-elastic moduli into the cements.[3] A suitable composition for the material is 58.2 percent ZnO, 27.3 percent Al_2O_3, 5.4 percent rosin, and 9.1 percent methyl methacrylate copolymer in the powder, and 62.5 percent EBA and 37.5 percent eugenol in the liquid; a powder-to-liquid ratio of 1.2 g per 0.2 cm^3 was used.

In a nine-month clinical study of 50 restorations, all restorations remained serviceable and only minimal signs of wear appeared. The new material was easily inserted in the prepared cavities and was well tolerated by the oral tissues. It is hoped that more extensive clinical studies on these materials will prove conclusively their great usefulness as semipermanent restoratives.

Another application of EBA cements is based on recent studies at Walter Reed Army Medical Center.[4] Investigations of the EBA cements as an indirect pulp capping material demonstrated not only that tooth pulp responds favorably to the cements, but also that a layer of reparative dentin forms after treatment with the EBA formulation. This behavior, combined with its excellent sealing characteristics, should make EBA cements beneficial for use over pulps recently injured by deep and extensive operating procedures.

[1] For further details, see Brauer, G. M., White, E. E., and Moshonas, M. G., The reaction of metal oxides with o-ethoxybenzoic acid and other chelating agents, J. Dent. Res. 37, No. 5, 547 (1958).

[2] Brauer, G. M., McLaughlin, R., and Huget, E. F., Aluminum oxide as a reinforcing agent for zinc oxide-eugenol-o-ethoxybenzoic acid cements, J. Dent. Res. 47, 622 (1968).

[3] Brauer, G. M., Huget, E. F., and Termini, D. J., Plastic modified EBA cements as temporary restorative materials, J. Dent. Res. (to be published).

[4] Bhaskar, S. N., Cartwright, D. E., Beasley, J. D., and Boyers, R. C., Pulpal response to four restorative materials, Oral Surg., Oral Med., Oral Path. 28, No. 1, 126 (1969).

In a joint experiment, E. Andrusko (left) and W. E. Little (center), NBS, and R. Gray, USAF Rome Air Development Center, successfully measured the power output of a 60 kW, cw, 7.97 GHz klystron amplifier using a power measurement technique employing directional coupler-bolometer mount combinations in a "mainline cascade system." The measurement apparatus (center) consists of standard NBS microwave power calibration equipment built around X-band, WR 90, waveguide.

HIGH-LEVEL MICROWAVE POWER MEASUREMENTS

MICROWAVE MEASUREMENT ENGINEERS from the NBS Institute for Basic Standards and the U.S. Air Force have successfully demonstrated the feasibility of a new measurement technique to determine high-level, continuous wave, microwave power with greater accuracy than is now possible with conventional high power measurement methods. In a joint experiment, sponsored by the Advanced Research Projects Agency, with NBS furnishing the precision measurement apparatus and the Air Force furnishing the high-level power generation equipment, measurements of 60 kW, cw, microwave power were made with uncertainty of less than 4 percent. The measurements were made by W. E. Little, K. E. Bramall, and E. Andrusko of the NBS Boulder laboratories and R. Gray of the USAF Rome Air Development Center.

In radars, microwave ovens, communications systems (particularly the space and satellite variety), and defense warning systems, the microwave frequency power levels are necessarily high. Since most power measurements at these high levels have errors of approximately 10 percent, the equipment is commonly "overdesigned" and "overpowered" to ensure that the output power meets minimum performance requirements. This practice is frustrating to the designer and costly to the user of the equipment.

The joint NBS–USAF experiment was conducted to determine if more accurate power measurements could be made and thereby permit the reduction or elimination of overdesign and overpower. An NBS developed low power measurement technique was selected to measure the high power output of a klystron amplifier, the type commonly used in military radars. The measurement apparatus consisted of a standard NBS microwave power calibration equipment built around X-band, WR 90, waveguide. Some 3000 pounds of equipment were shipped from Boulder, and reassembled at the Air Development Center in Rome, N.Y., where it was connected to a 60 kW output, 7.97 GHz klystron amplifier powered by a 230 kW power supply.

Because of the high power levels and the heat generated, an extensive water-cooled heat exchange system was necessary to cool the electronic equipment. A 20 gpm flow rate cooled the measuring equipment while an 80 gpm flow rate cooled the klystron amplifier.

The NBS measurement technique chosen for this experiment is based upon a well developed low power measurement method using directional coupler-bolometer mount combinations in a "mainline cascade system," with the coupler serving as a power divider and the bolometer mount serving as a power meter. A coupler-mount combination offers

several advantages as a means to make high power measurements: The directional coupler samples a small portion of the total power, the calibration is independent of source characteristics, the coupler provides a small equivalent generator reflection coefficient, and the coupler can be used as a feed-through rather than as a terminating-power meter.

The mainline cascade system uses a number of directional coupler-bolometer mount combinations, each having successively larger coupling ratios (the ratio of line power to the sampled power), arranged in a cascaded or series fashion. One calibrated coupler-mount combination is used to calibrate another and is then removed from the system. This sequence is repeated until the unit with the largest coupling ratio has been calibrated and all of the other units have been removed from the system. This last unit is then used as a feed-through high power meter. Cascading of the directional coupler-bolometer mount combinations prior to calibrating the selected low power combination minimizes the total uncertainty.

WIDE RANGE POWER MEASUREMENT TECHNIQUE

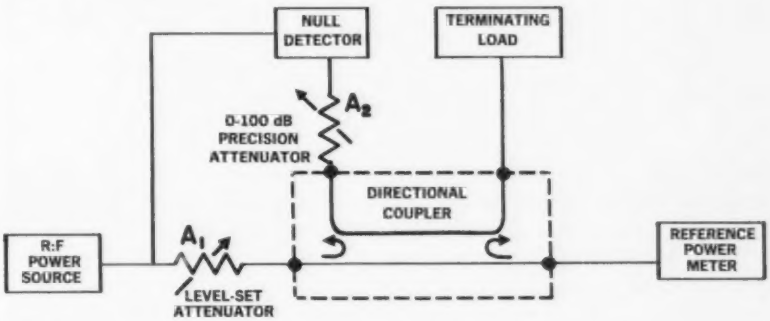
An Accurate Technique for determining the power delivered to a load has been developed at the Boulder (Colo.) laboratories of the Bureau by R. A. Lawton, C. M. Allred, and P. A. Hudson. The new technique may be used over a wide range of power and frequency to calibrate or measure the sensitivity of detectors, receivers, radiometers and other instruments.

The method is more accurate than other known measurement procedures. At the test frequency of 30 MHz and at power levels down to 10^{-14} watt the uncertainty is reduced by a factor of 2 to 6. It is expected to be applicable over the entire range of radio frequencies and for power up to where arcing or excessive heating occurs (>100 kW), a variation of 190 dB.

In operation, a convenient power is first applied through a level set attenuator and directional coupler to a reference power meter. Signals proportional to the incident and reflected waves at the power meter are available at the coupler side-arm ports, and the ratio of these side-arm signals is measured by means of a precision attenuator and null detector, switched between the side-arms. Finally, the instrument to be calibrated is substituted for the reference power meter, the power is adjusted to the calibration level using the level set attenuator, and the side-arm voltage ratio is again measured. The data obtained yield accurate values for the power actually delivered to the instrument under calibration.

There are significant advantages of the new method over a simple attenuation of input power. Both incident power and reflected power are determined, the difference being the power absorbed by the load. The reference power may be any arbitrary value chosen to make the reference power meter most accurate, while the power established in the load may be very much different, substantially exceeding the range of "normal" instrument capability.

The uncertainty of the method at 30 MHz is calculated to be between 0.5 and 1.5 percent when using a power meter with an uncertainty of 0.5 percent. The precision attenuator used was accurate to within 0.001 dB per 10 dB over its range, while the directional coupler was a commercial unit with a 10 dB coupling factor, modified to improve directivity and reduce sensitivity to spurious leakage signals. The null detector used phase detection referenced to the input to increase the sensitivity at very low power levels.



Wide-Range Power Measurement System. The detector is in position to measure the incident wave voltage. The terminating load and detector are interchanged for measuring the reflected wave. A_1 sets the power to the load, but need not be of high precision, since the measurement is made by A_2.

ACOUSTIC CAVITATION RESEARCH AT NBS

ACOUSTICAL CAVITATION, for many years a problem in hydraulics and a source of noise from a ship's propeller, is now being used to study various properties of liquids. An interesting by-product of the research is possible application of cavitation to nuclear instrumentation. In recent work, by M. Greenspan and C. E. Tschiegg at the NBS Institute for Basic Standards, neutron irradiation, α-disintegrations, and fission have been used to induce cavitation in various liquids subjected to sound pressures.[1, 2] Their work has greatly added to the general knowledge of cavitation in such areas as influence of various nuclei, threshold values, the rate of cavitation as a function of sound pressures, and the design of cavitation cells.

Cavitation can be induced in a nondegassed liquid contained in a cell at atmospheric pressure by increasing sound amplitude. The sound vibrations exert fluctuating positive and negative sound pressures on the liquid. When the negative sound pressure or tensile phase of the stress is sufficiently high, the liquid will rupture or cavitate. The cavitation originates from gas or vapor bubbles stabilized on motes or on poorly wetted motes.

NBS work has shown that motes can be removed, by circulating the liquid through a filter, to the point that increased negative sound pressure will not rupture the liquid. Cavitation can be induced in these "clean" liquids, however, by exposing the liquid to ionizing radiation. Cavitation has been induced by radiation in water, isopropanol, freon 113, ethanol, methanol, and other liquids. In most cases (α,n) sources were used.

The cell used in the cavitation experiments was usually a cylinder constructed of piezoelectric ceramic. It is generally 7.5 cm OD and from 7.5 to 10 cm in height. The cylinder serves as the container, as the driving transducer, and as the pickup.

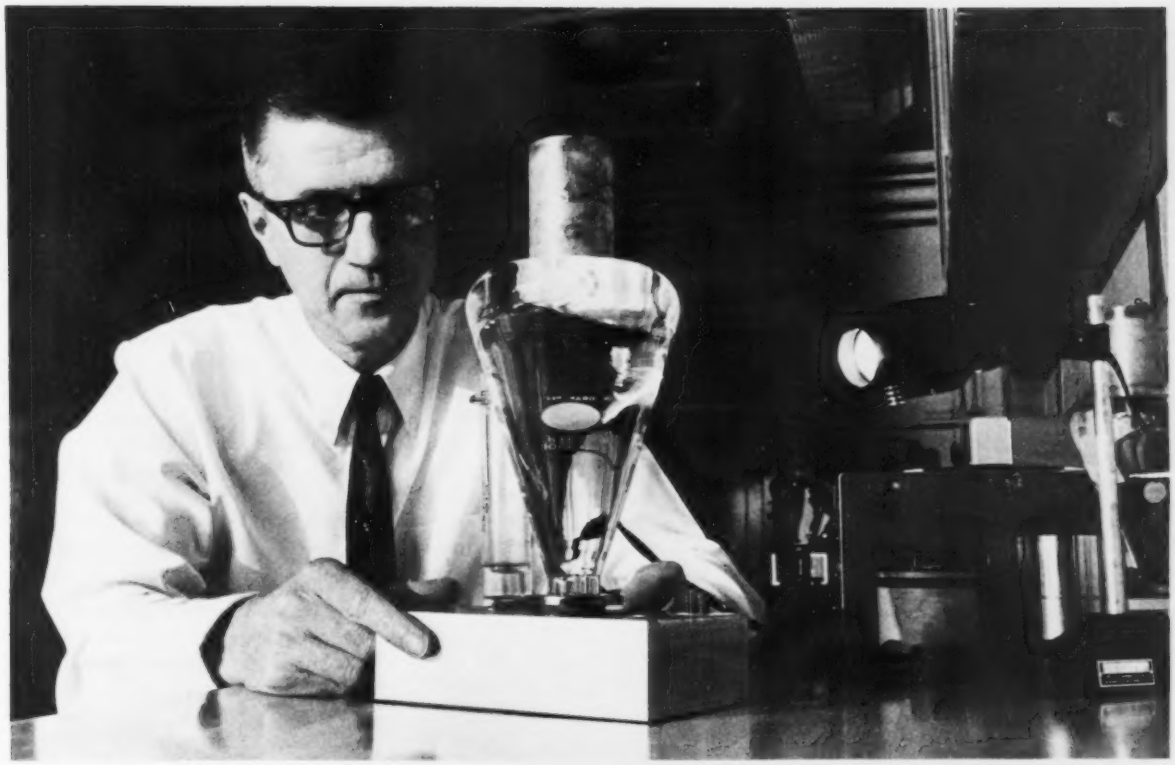
A cavitation detector rectifies and differentiates the amplified output of the cell. A cavitation event drops the Q of the system and therefore the output amplitude. The resulting pulse can be made to trip a relay, which interrupts the voltage supply to the level set, stopping the oscillation. The rectified signal is amplified and applied to a small loudspeaker so that the cavitation events can be heard.

While the majority of the cells used in the NBS work were cylinders, conical flasks have been found feasible in some cases. The conical cells are constructed from Erlenmeyer flasks by replacing the necks with glass plugs. A ceramic transducer is cemented to the bottom of the cell and serves for both input and output. Advantages of these assemblies are their one-piece and inexpensive construction.

The results of this work show that in clean liquids exposed to neutrons, the cavitation rate rises rapidly with acoustic (negative) pressure, and at a fixed pressure, is proportional to neutron flux. The cavitation events are random, and no appreciable induction or decay times are apparent. Each cavitation arises from the action of a single neutron (or α-recoil, or fission). The cavitation threshold (negative pressure below which cavitation is rare or nonexistent) is highly variable from liquid to liquid. Thresholds at about room temperature for liquids irradiated with 10 MeV neutrons ranged from 1 to 2 bars for n-pentane, ether, and freon 113, to over 50 bars for water.

In the case of neutron irradiation, cavitation apparently results from the kinetic energy acquired by an atomic nucleus of one of the heavier elements in the liquid as a result of an elastic collision with a neutron. In the case of α-disintegration and of fission, the sources are in solution in the test liquid, in which case heavy recoil nuclei are responsible.

Cavitation research at this point is still preliminary. The work has shown,



Above: C. E. Tschiegg prepares a cell for an acoustical cavitation experiment. Right: Conical cell used in acoustical cavitation research is constructed from an Erlenmeyer flask by replacing the neck with a glass plug and cementing a transducer to its bottom. The hypodermic syringe controls the pressure on the liquid contained in the cell (tube connection not visible).

however, that cavitation events can be consistently controlled and reproduced. The technique is expected to yield valuable data on liquids, in such areas as tensile strength as a function of temperature, and has possible applications to nuclear measurements, especially neutron threshold detection.

[1] Greenspan, M., and Tschiegg, C. E., Radiation-induced acoustic cavitation; apparatus and some results, J. Res. Nat. Bur. Stand. (U.S.), 71C (4), 299–312 (1967).

[2] Greenspan, M., and Tschiegg, C. E., Cavitation nucleated by $B^{10}(n,\alpha)Li^7$, Nucl. Inst. Meth. (in press).

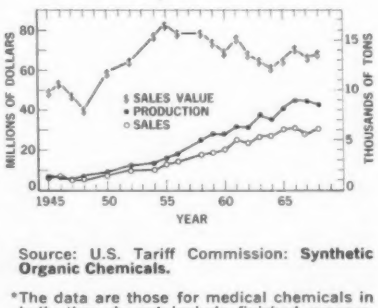
GROWTH OF SYNTHETIC FOOD/FEED INDUSTRY SURVEYED

A relatively new and expanding industry that stands out as one alternative to massive starvation and malnutrition is that of synthetic food and feed. Large scale production will depend not only on further research and engineering developments but also on effective planning for utilizing the potential of this young industry. Statistics of annual production, sales, and value of synthetic foods now produced are needed to provide government and technical leadership with guidelines for projecting industry development. A statistical survey of the growth of this industry is being conducted by Mary Nan Steel of the NBS Institute for Materials Research.[1]

Two-thirds of the world's population live in areas where the available natural foods fail to provide man's daily requirement of calories and proteins. Although the major role of synthetic food at present is to supply the lacking essential nutrients in natural products, it could be that of providing a significant source of world food supply if necessary. Synthetic foods and feeds do not depend directly on the land but are produced by chemical synthesis and by biochemical methods from industrial and agricultural waste products, liquid petroleum, and natural gas. As defined in this survey, "food" is any item that enters the human diet.

For the purposes of this statistical study, synthetic products were classified into three categories based on volume of production and unit value. The first category includes small volume/high unit value items such as vitamins and amino acids. These products range from vitamin B_{12}, of which 3000 pounds were produced in the United States in 1968, selling at $3071 per pound, to the amino acid methionine (and its hydroxy analog), of which 5098 tons were sold in the same year at $0.65 per pound.

*Figure 1. U.S. Vitamin Production and Sales**



Source: U.S. Tariff Commission: **Synthetic Organic Chemicals.**

*The data are those for medical chemicals in bulk; they do not include finished preparations such as tablets and capsules manufactured from bulk chemical.

U.S. vitamin production and sales show a relatively steady and close trend upward. Manufacturers control the output to meet sales demands and thus prevent either over supply or under production. As export markets increase, production increases over sales as indicated. Fluctuation in dollar sales from year to year reflects the fact that the data include different items, in varying quantities, sold over a wide and changing range of prices.

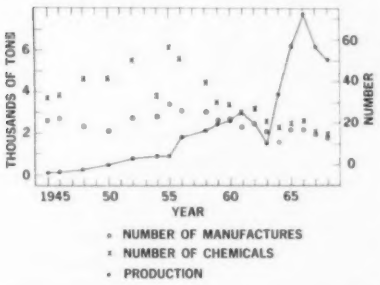
Production and sales statistics for vitamins are shown in figure 1. By 1945 the vitamin market was well established; in that year 2 945 000 pounds of vitamins were produced, selling at $3.42 per pound for niacin to $457 per pound for vitamin B_6. Each year the data include different vitamins, sold in varying amounts over a wide range of prices. This is reflected in the fluctuation of dollar sales from year to year. Often, newly synthesized items come onto the market at very high prices. Vitamin B_{12}, first introduced in 1952 at $91 787 per pound, is an extreme example.

Lowered prices over the years also reflect improved manufacturing processes. In turn, lower prices bring greater demands and production increases as the manufacturer controls output to meet demand. Natural food supplies that depend on the caprices of nature do not have this advantage. In 1968 vitamin production was six

times that of 1945, and over the years 36 different manufacturers have produced one or more of these items.

Amino acid production in the U.S. at the present time is around 80 times that of 1945. An interesting fact, from the point of view of expansion, is that 29 manufacturers have produced up to 56 different chemicals in this category over a 25-year period. The fact that such a large number of amino acids, salts, and derivatives have been made over the years in experimental quantities indicates a possibility that quick expansion to large scale production could be effected if the need arises in the decades ahead.

Figure 2. U.S. Amino Acid Production



Source: U.S. Tariff Commission: **Synthetic Organic Chemicals.**

Production statistics of amino acid vary over the years; as many as 56 chemicals produced by 29 different manufacturers have been included. Methionine is the principal item in the production figure at present.

Though the prices of some of the vitamins and amino acids seem extremely high, the very small quantities required in the diet add only a few cents to the cost of food products in which these items are used in fortification.

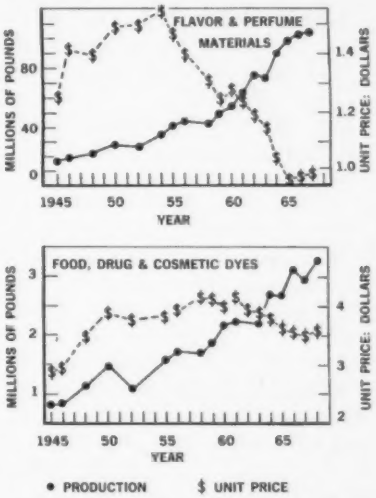
Keeping in mind that the eating habits of man are slow to change and that synthetic food products introduced on the market must be pleasing in texture, consistency, odor, color, and taste, data were included on production of aesthetic constituents. Synthetic flavors and dyes, a part of the first production category, have had an important place in the food market for a longer period of time than any of the other synthetic materials being surveyed; in fact, ninety-nine percent of the dye industry is now synthetic. Total production in 1967 was approximately 115 000 pounds, with flavors selling at an average of $0.97 per pound and dyes selling in a price range of $2.59 to $12.82 per pound. Production in 1967 was over five times that in 1945. Since 1950 monosodium glutamate has dominated the flavor market, of which it is one-third. During the decade preceding 1965, prices of flavors and coloring materials on the whole followed a steady downward pattern, but in 1965 inflation began to effect an upward price trend. In spite of this fact, the firm place of these aesthetic constituents can be seen in the continuing increase in production.

At this time, single-cell proteins comprise the intermediate production/intermediate value category. The quantity and value of shipments are used as a measure of production in the U.S. In 1963, 50 million pounds were shipped, of which 35 percent was food yeast. Any changes in the quantities held in stock in plants producing the yeast would probably represent only a fraction of the annual production.

Thirty-five countries have production facilities for yeast products, but the large scale production that is in prospect will involve the culture of single-cell organisms on petroleum. Specialists note that just 2 percent of the yearly output of crude petroleum would suffice to produce the yearly protein requirements of 2 billion people.

At present, urea is the only commodity in the third category, large volume/low unit price. The first natural substance to be made from nonliving material, urea is produced in the greatest amount and sells at the smallest price of all synthetic materials. The demands for urea as a cattle feed and as an agricultural fertilizer continue such that the world capacity for urea production should reach 12–16 million metric tons in 1970 selling at $0.03-$0.04 per pound.

Figure 3. Aesthetic Constituents—U.S. Production and Unit Price



Source: U.S. Tariff Commission: **Synthetic Organic Chemicals.**

The aesthetic constituents illustrate the classical trend of production and unit price. At first the unit price is high, but with more efficient production processes and increased production a gradual lowering of price occurs. The effects of inflation appear around 1965.

Statistical data for the synthetic industry necessarily are interpreted and projected in light of several limiting factors. The newness of the industry has prevented the release of proprietary information. Many products have not been manufactured in sufficient quantities or for a sufficient length of time to show well defined trends. Yearly comparison of production is difficult because the categories—vitamins, amino acids, etc.—change in composition from year to year. Production statistics for other countries are difficult to find and conclusions are based on U.S. import statistics. Despite these limitations, sufficient data have been collected to indicate this industry's capabilities.

[1] Steel, M. N., Growth of Synthetic Food and Feed Production, presented at the 134th Meeting of the American Association for the Advancement of Science, December 28, 1969, Boston, Mass.

SIMPLE INTERFEROMETRIC METHOD TESTS OPTICS

A SIMPLE INTERFEROMETRIC METHOD for evaluating optics in the workshop has been developed at the NBS Institute for Basic Standards. The procedure,[1] devised by J. B. Saunders of the Metrology Division, utilizes a wavefront shearing interferometer and requires only simple arithmetic to achieve accurate results. The method can be used by opticians in the workshop to produce optics with specific characteristics and is quite practical for the final testing of optics for performance ratings.

The shearing interferometer used in this procedure is basically a cube-shaped prism, consisting of two cemented components, and a light source. Shear is obtained in construction of the prism by a small rotation of one component prism relative to the other.[2]

The light source may be a single filament miniature lamp, a single filament galvanometer lamp with a filter, monochromators with slit apertures, spectral line sources behind slits, or lasers with spatial filters.

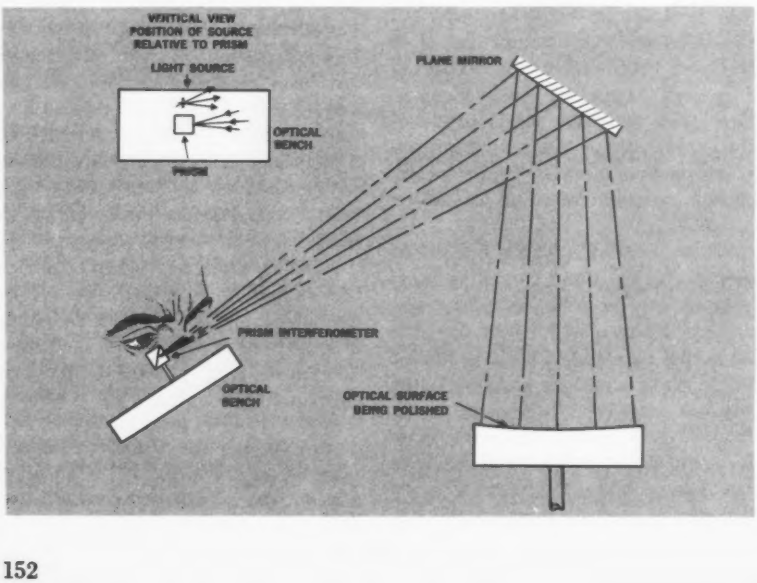
It is recommended that at least three prisms, having approximately 3, 6, and 12 milliradians of shear, be available for general testing of optics in an optical shop. The cost of making several prisms is much less than the construction of any currently known interferometer of variable shear.

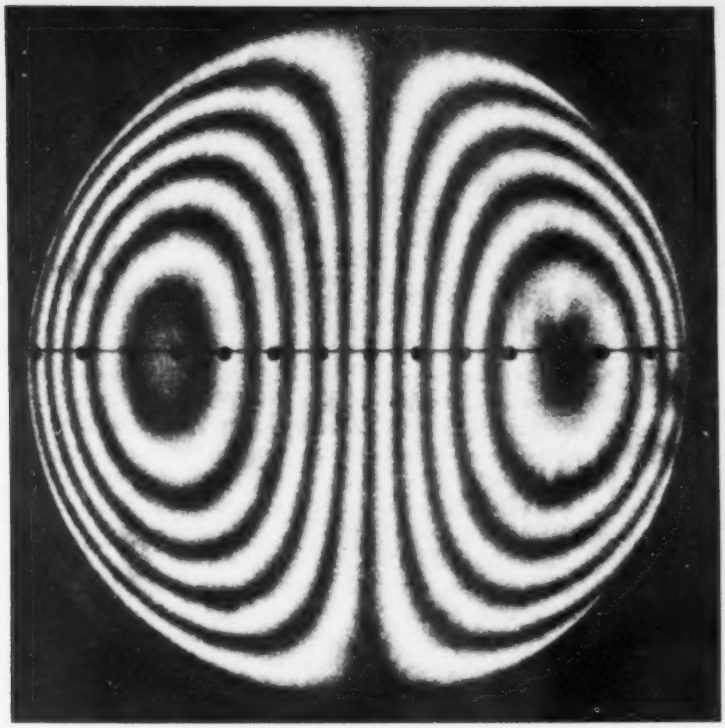
The prism interferometer can be used to visually inspect and evaluate optics. A perfect objective, which produces a spherical wavefront, will produce straight fringes in the interferometer. If the lens is afflicted with aberrations, the wavefront will not be spherical and the fringes will not be straight.

The fringe pattern can be photographed for a more accurate analysis. In this analysis, the optician marks off or inserts a set of reference points on the photo along a diameter of the pattern parallel to the shear. The separation of the points must be equal to the lateral shear. This set of points is also the X axis of an X-Y coordinate system. By then measuring the distance of the points from the origin and plotting the orders of interference corresponding to the reference points, a graphic representation of the wavefront is obtained. By then plotting a straight line, and performing several arithmetic calculations, deviations of the wavefront of the specimen under test from a perfect sphere can be obtained.

The procedure, when used to produce predetermined optical configura-

Set-up of equipment for producing optics to a predetermined configuration.





Fringe pattern of a parabolic mirror obtained with a wavefront shearing interferometer, shows orders of interference and reference points. Such patterns can be analyzed in fourteen steps, none of which require more than simple arithmetic and plotting of graphs.

tions, is based on the fact that if the specifications of a lens or mirror are known, its fringe pattern can be computed and drawn to any desired scale. The computed pattern can then be visually compared with the fringe pattern produced by the piece when tested with this interferometer. This allows the optician to make changes in a surface (by polishing) to produce fringes that agree with the previously computed fringe pattern, thus achieving the desired configuration.

The method has been used at NBS to evaluate optics and to produce mirrors of a desired shape. Demonstrations have shown that an optician, with only limited experience with the system, soon was able to polish a mirror surface to produce fringes agreeing with those previously computed for the mirror, thus arriving at a desired configuration.

[1] For further details, see Saunders, J. B., A simple interferometric method for workshop testing of optics, Applied Optics (In press).

[2] Saunders, J. B., The wavefront-shearing interferometer, J. Res. Nat. Bur. Stand. (U.S.), 68C (3), 135 (July-Sept. 1964).

NBS PARTICIPATES IN RICE UNIVERSITY PRECEPTORSHIP PROGRAM

James L. Haecker, Building Research Division, NBS Institute for Applied Technology, has been appointed a Preceptor in the Rice University School of Architecture Preceptorship Program, Plan B. The Preceptee, Rick Gibson, began his Preceptorship at the NBS Building Research Division at the conclusion of the 1969–70 academic year.

Under the terms of the Preceptorship Program, selected students work and study in the offices of outstanding architects who are appointed as Preceptors by the President of Rice University. There are two programs. The Preceptorship B program is one year in duration, and is undertaken between the fourth and fifth years of study. Preceptorship A, open to students at the third-year level and above, is two weeks in duration. Both programs are designed to complement formal classroom studies in architecture by giving the student an opportunity to experience the realities of architectural practice.

The two-pronged mission of the Building Research Division as an integral unit of the Bureau is to stimulate innovation and to aid in the application of systems methodology. The Division has major responsibility for developing adequate measurement techniques for the Nation's building industry, and disseminating the results of its research by publishing and consulting with both private and public organizations concerned with the promulgation of building standards and codes.

This particular Preceptorship, therefore, offers an unusual opportunity for the Preceptee to acquaint himself with subjects of current importance in the field of building research.

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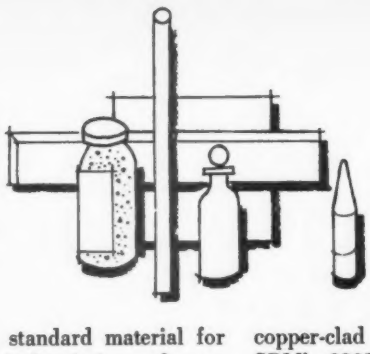
STANDARD REFERENCE MATERIALS



Standard Reference Materials are well-characterized materials certified for chemical composition or for a particular physical or chemical property. These materials are disseminated by NBS to be used to calibrate and evaluate measuring instruments, methods, and systems or to produce scientific data that can be referred readily to a common base.[1]

LEAD-BASE BEARING METAL STANDARDS

Lead-base bearing metal Standard Reference Materials have been prepared in the form of a metal powder as SRM 53e, which is the fifth renewal for this alloy first certified by NBS in 1921, and in disk form as SRM 1132, which is issued for the first time.

This lead-base alloy and similar alloys have long been used as type metal. More recently they have been applied as bearing materials, particularly in the automotive industry and in diesel engines in which bearings are components of more than 10 million vehicles produced annually in the United States alone. Control of chemical composition has become increasingly important and the content of major constituents such as antimony and tin and of minor elements such as arsenic, bismuth, copper, iron, and nickel have become the basis for acceptance or rejection. SRM 53e may be used in calibrating the methods and techniques of ASTM designations E 46, E 50, E 57, and E 87 for the analysis of lead-base alloys of similar chemical compositions.

SRM 1132 was prepared from the same lot of lead-base alloy from which SRM 53e was selected. It is intended to serve as a standard material for calibrating optical emission and x-ray spectrometric methods of analysis.

The standards were prepared from a 1500 pound lot of lead-base alloy SAE 13, which was converted by atomization into a fine metal powder. About 1000 pounds of the powder were used for the preparation of SRM 53e, and the remaining 500 pounds were converted into dense rods for use in SRM 1132. Both portions were tested extensively and found to be highly homogeneous. The chemical composition of SRM's 53e and 1132 is identical for all practical purposes.

SRM 53e may be purchased in 150-gram units of metal powder sized between 170 and 325 mesh sieves for $33 per unit; and SRM 1132, in the form of disks 1¼ inches (31.8 mm) in diameter and ¾ inch (18.8 mm) thick, may be purchased for $50 per unit.[2]

The material from which these standards were prepared was furnished by Alcan Metal Powders, Inc., Elizabeth, N.J., as alloy SAE 13, sized between 170 and 325 mesh sieves, and thoroughly blended.

Cooperating with NBS in the analysis of the alloy were the St. Joseph Lead Company, Zinc Smelting Division, Monaca, Pa., and the American Smelting and Refining Company, South Plainfield, N.J.

GOLD COATING THICKNESS STANDARDS (Weight Per Unit Area)

Two new series of Standard Reference Materials of gold coatings—on clad epoxy and on copper—are now available through the NBS Office of Standard Reference Materials.

The first series of gold on 1 oz/ft² copper-clad glass epoxy, designated SRM's 2301, 2302, 2303, and 2304, may be purchased from stock separately or in the combinations below. The laminate is 33 to 38 μm (1.3 to 1.4 mil) of copper on glass epoxy sheet and is equivalent to ASTM Grade 10.

SRM No.	Nominal Coating Weight (mg/cm²)	Nominal Thickness (microinch)	Price[2]
2301	1.5	30	$48
2302	3.0	60	48
2303	6.0	120	48
2304	14.0	280	48
2305	one each of 2301 and 2302		73
2306	one each of 2302 and 2303		73
2307	one each of 2303 and 2304		73
2308	one each of 2301, 2302, 2303, and 2304		123

The second series of gold on copper coating standards, designated SRM's 2311, 2312, 2313, and 2314, may be purchased from stock separately or in the combinations below.

SRM No.	Nominal Coating Weight (mg/cm²)	Nominal Thickness (microinch)	Price[2]
2311	1.5	30	$48
2312	3.0	60	48
2313	6.0	120	48
2314	14.0	280	48
2315	one each of 2311 and 2312		73
2316	one each of 2312 and 2313		73
2317	one each of 2313 and 2314		73
2318	one each of 2311, 2312, 2313,and 2314		123

STANDARD FOR LINEAR THERMAL EXPANSION—COPPER

Copper as a thermal expansion Standard Reference Material has been made available through the NBS Office of Standard Reference Materials as SRM 736. This is the first of a series of materials that will be certified for thermal expansion. The complete series will cover the temperature

range from 20 to 1900 K and will have coefficients of thermal expansion in the range of 0.5 to 25×10^{-6}/K. It should be of particular interest to laboratories making measurements using relative methods of expansion measurements such as push-rod dilatometers.

Laboratories that measure thermal expansion have a definite need for reliable and accurate standards. Experience has shown that variations of the order of a few hundred parts per million in $\Delta L/L$ are not uncommon among laboratories using push-rod dilatometers. The thermal expansion of the 99.99 percent pure copper, SRM 736, has been accurately determined over the temperature range 20-800 K.

SRM 736 was developed for use in testing and calibrating thermal expansion apparatus and techniques. Homogeneity of this material has been established by extensive testing at NBS so that it is suitable for interlaboratory comparisons.

SRM 736 is available as ¼-inch (6.4 mm) rods, in 2-, 4-, and 6-inch (51, 102, and 152 mm) lengths designated as L1, L2, and L3 respectively. Inquiries for longer length continuous rods may be directed to the Office of Standard Reference Materials. The prices of SRM 736 are: L1–$71, L2–$119, and L3–$167.[2]

GLASS VISCOSITY STANDARD

A new glass viscosity standard, SRM 717, a homogeneous borosilicate glass in the form of a block approximately 4.2 by 4.2 by 12.5 cm, has been prepared and is now available from the NBS Office of Standard Reference Materials.

The new standard, together with SRM 710, a soda-lime glass,[3] and SRM 711, a lead-silica glass,[4,5] completes a series of types of glasses that are most widely used in industry. The glass from which SRM 717 was prepared has a nominal chemical composition of:

SiO_2–70 percent	Na_2O–1 percent
B_2O_3–17 percent	Al_2O_3–3 percent
K_2O–8 percent	Li_2O–1 percent

SRM 717 is not intended as a standard for chemical analysis and the above composition is offered only for information purposes.

The new standard reference material not only offers another viscosity standard for calibrating instruments used to measure properties of glass at elevated temperatures, but also a type of glass used in the electrical industry as a sealing glass. This glass has the desired electrical and dilation properties and fairly good chemical durability to perform as a sealing glass. It is suitable for "kovar" seals having a linear coefficient of thermal expansion of about 51.5×10^{-7}/°C.

Viscosity measurements were made by Institute staff members, A. Napolitano and E. G. Hawkins, on this glass between the temperatures 470 and 1460 °C or from $\log_{10}$ 15.0 down to $\log_{10}$ 2.0. These data, together with data submitted by four cooperating research laboratories—Corning Glass Works, Corning, N.Y.; Emhart Manufacturing Company, Hartford, Conn.; Owens-Illinois, Toledo, Ohio; and Thatcher Glass Manufacturing Company, Inc., Elmira, N.Y.—were tabulated in a certificate of viscosity values. Measurements were made by the rotating cylinder, fiber elongation, beam-bending, and parallel-plate methods.

The softening, annealing, and strain points of the new standard glass have also been determined by each laboratory and are reported on the certificate. These measurements were made according to ASTM Test Designation C 338-57 (reapproved 1968) for softening point of glass and C 336-69 for annealing point and strain point of glass.

The price of SRM No. 717, a block weighing about 500 grams, is $71. A certificate of viscosity values is supplied with each unit.

LOW CARBON STAINLESS STEEL (CARBON ONLY)

SRM 166c, low-carbon stainless steel, replaces SRM 166b. This material is an AISI Type 316L steel certified for carbon content only. It was prepared in powder form by the Hoeganaes Corporation, Riverton, N.J., and sized between 25 and 200 mesh sieves and has a certified carbon content of 0.0078 per cent.

Analyses leading to the certification were made in cooperation with the Bureau by Interlake Steel Corporation; Armco Steel Corporation; United States Steel Corporation; Laboratory Equipment Corporation; and Westinghouse Electric Corporation.

SRM 166c may be purchased in units of 100 grams for $25 per unit.[2]

HIGH SILICON STEELS

SRM 125b, high-silicon steel, replaces SRM 125a. The material for preparation of SRM 125b was supplied by the Armco Steel Corporation, Middletown, Ohio. SRM 1134, with the same chemical composition as SRM 125a, is available as disks 1¼ inches in diameter and ¾ inch thick. SRM 1134 is primarily for use in optical emission and x-ray spectrometric methods of analysis. Analysis leading to the certification were made in cooperation with NBS by United States Steel Corporation and Armco Steel Corporation.

SRM 125b is supplied in units of 150 grams for $33 per unit.[2] SRM 1134 costs $50 per unit.[2] Certificates of Analysis are supplied with each standard.

[1] For a complete list of Standard Reference Materials available from NBS, see **Standard Reference Materials: Catalog and Price List of Standard Materials Issued by the National Bureau of Standards**, NBS Spec. Publ. 260 (July 1969 ed.) for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, for 50 cents; order by SD Catalog No. C13.10:260. Insert sheets that update Spec. Publ. 260 are supplied to users on request.

[2] These standards may be purchased for the price indicated from the Office of Standard Reference Materials, Rm. B308, Chemistry Bldg., National Bureau of Standards, Washington, D.C. 20234.

[3] **Viscosity Standard Sample of Glass**, Nat. Bur. Stand. (U.S.), Tech. News Bull. **46** (11), 174 (Nov. 1962), and **Viscosity of Standard Soda-Lime-Silica Glass**, J. Res. Nat. Bur. Stand. (U.S.), **68A** (Phys. and Chem.), No. 5, 439 (Sept.-Oct. 1964).

[4] **New Glass Viscosity Standard**, Nat. Bur. Stand. (U.S.), Tech. News. Bull. **49** (3), 43 (Mar. 1965).

[5] **Viscosity of Standard Lead-Silica Glass**, Nat. Bur. Stand. (U.S.), Misc. Publ. 260–11 (Nov. 1966, 25 cents). Order by SD Catalog No. C13.10:260-11, from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

CONFERENCE & PUBLICATION *Briefs*

POLICY PLANNING SYMPOSIUM HOSTED

The Bureau hosted, on March 9–10, 1970, a Symposium on Assessing the Future and Policy Planning at which over 200 analysts and decision-makers gathered to discuss various aspects of this theme. The attendees came from industrial, consulting, and research firms, as well as from many Government agencies; most were from the Washington area (including several from foreign embassies), but many came from other parts of the United States and Canada.

The Symposium opened with a keynote address by Raymond Bauer, Director of the National Goals Research Staff. The sessions following centered around four main topics: (1) techniques for assessing the technological, economic, and social aspects of the future, (2) alternative future environments and their implications for planning, (3) problems in integrating the future into policy planning, and (4) specific implementation experience. The banquet address was given by Congressman Charles A. Mosher, of the Subcommittee on Science, Research, and Development.

Two contemporary themes recurred throughout the sessions. The first concerned the need of establishing national goals and priorities and the second identified the quality of our environment and its contributing determinants as an essential consideration in all policy decisions.

The Symposium was organized by the Washington Chapter of The Institute of Management Sciences (TIMS) and cosponsored by the National Bureau of Standards and the World Future Society. Proceedings of the Symposium will be published in book form, to be available within a few months. For additional information contact: Dr. Bernard Levin, Room B109 Technology Building, National Bureau of Standards, Washington, D.C. 20234.

NBS TECHNICAL HIGHLIGHTS

The status of the U.S. Metric Study and a variety of consumer problems are among leading topics in *NBS Technical Highlights: 1969*, Special Publication 325 [1] ($1.25; SD Catalog No. C13.10:325). This latest annual report of the Bureau covers its activities from July 1, 1968, to June 30, 1969. The metric study—a congressionally mandated inquiry by NBS into the impact of increasing worldwide usage of the metric system on the United States—is now passing the half-way mark and was well under way during the period reviewed in the *Highlights;* the book's introductory chapter summarizes the study's progress, reviews staff and organizational changes at NBS, and notes developments related to automotive safety and to broader protection from flammable fabrics. This is followed by a feature on the rapidly expanding program of the Bureau's Center for Computer Sciences and Technology.

Among the significant scientific and technical advances briefly noted in the main body of the report are:

- Construction of two highly stabilized helium-neon lasers with frequencies in agreement to one part in a hundred billion, offering a basis for a possible 300-fold more accurate definition of the meter.
- Improved calibration of laboratory standard microphones at frequencies down to about 1 Hz, a valuable service for purposes of measuring low-frequency noises, including sonic boom.
- Technical consultation with industry in developing improved radio frequency pulse power meters, designed to improve accuracy and reliability of airborne systems vital to military and civilian flight safety.
- Development of super-purity aluminum with residual resistance ratios up to 45 000, expected to have use in magnets and other commercial applications and to be valuable in physical and mechanical property measurements.
- Design and construction of a computerized scanning microscope image-processing system being used by biologists to help analyze central-nervous-system tissue and white blood cells.
- Calibration of the cameras used by Apollo IX to photograph the moon.
- Experimental work on a new measuring device for checking stray radiation from microwave ovens.
- Studies of the magnetic behavior of organometallic complexes important in biological processes involving enzymes and proteins with trace metal ions.
- Improved polarographic methods for simultaneously analyzing low-level air pollutants including iron, copper, cadmium, and lead.
- Demonstration of the unique molecular structure of polywater in a collaborative study with the University of Maryland.
- Development of a torsion pendulum system for determining elastic properties and internal friction of dental materials.
- Research on tires, seat belts, braking systems, vehicle structure and other aspects of automotive safety.

A series of appendixes summarizes the organization and finances of NBS and lists winners of awards and honors, principal staff members, research associates and guest workers, and members of the visiting committees and of the various technical advisory panels. It also lists the year's publications and patents by NBS staff members.

DURABILITY OF INSULATING GLASS

The proceedings of a seminar on the Durability of Insulating Glass have been edited by Henry E. Robinson for publication as NBS Building Science Series 20[1] (75 cents; SD Catalog No. C13.29/2:20). The definite advantages of factory-sealed double-glass insulating units have led to their increasing use in both Government and privately owned buildings. A problem has arisen, however, in the form of seal failure in some of the units, causing moisture penetration of the air space and ultimate fogging and loss of clear vision through the unit. Concern about this problem among users, fabricators, and specifiers of insulating units brought about the seminar for the purpose of exchanging information and ideas on improving the reliability of seals. The meeting was sponsored jointly by the National Bureau of Standards, the American Society for Testing and Materials (Committee E–6), the Building Research Institute, and the Construction Specifications Institute.

THREE YEAR INSPECTION OF PORCELAIN ENAMELED ALUMINUM

Studies begun in 1956 indicated that accelerated tests giving good results for porcelain enamels on steel were not reliable indicators of the weatherability of the new, lower-firing enamels applied to aluminum. Consequently another study was initiated by the Porcelain Enamel Institute and the National Bureau of Standards to investigate these findings further by more comprehensive exposure tests to develop improved accelerated tests. The first results of this study are described in the publication, *1964 Exposure Test of Porcelain Enamels on Aluminum: Three Year Inspection,* by Margaret A. Baker, NBS Building Science Series 29[1] (25 cents; SD Catalog No. C13.29/2:29).

Included in the test were 16 enamel systems in one and two coats, nine colors, and three gloss ranges, which were exposed at sites in Los Angeles; Washington; New York; Kure Beach, N.C.; and Montreal. After 6 months, 1 year, and 3 years, specimens were returned to NBS and measured for changes in gloss and color. Results of all three inspections are reported. The boiling citric acid test, used as an acceptance test for these enamels, did not correlate as well as expected with color change. A cupric chloride test was developed that showed an improvement in this correlation.

SCHEDULED NBS-SPONSORED CONFERENCES

Each year NBS sponsors a number of conferences covering a broad range of topics in science and technology. The conferences listed below are either sponsored or cosponsored by NBS and will be held at the Bureau's Gaithersburg, Md., facility unless otherwise indicated. These conferences are open to all interested persons unless specifically noted. Inquiries should be sent to the person indicated below in care of Special Activities Section, Room A600, Administration Building, National Bureau of Standards, Washington, D.C. 20234.

55th National Conference on Weights and Measures. July 12–17. Contact: H. F. Wollin (NBS Office of Weights and Measures). To be held at the Hotel Utah, Salt Lake City, Utah.

International Conference on Precision Measurements and Fundamental Constants. Aug. 3–7. Cosponsors: IUPAC; CODATA; NAS–NRC; International Bureau of Weights and Measures. Contact: E. Ambler (NBS Institute for Basic Standards).

Space Simulation Conference. Sept. 14–16. Cosponsors: American Institute of Aeronautics and Astronautics; Institute of Environmental Sciences; American Society for Testing and Materials. Contact: J. C. Richmond (NBS Heat Division).

National Conferences on Metrication. Sept. 21–25, Oct. 12–16, and Nov. 16–20. Contact: J. Odom (NBS Office of Invention and Innovation). To be held at Department of Commerce Auditorium, Washington, D.C.

25th Calorimetry Conference. Oct. 19–22. Contact: E. Domalski (NBS Physical Chemistry Division).

4th Materials Research Symposium. Oct. 26–30. Contact: L. A. Wall (NBS Polymers Division).

The Science of Ceramic Machining and Surface Finishing. Nov. 2–4. Cosponsors: Office of Naval Research; American Ceramic Society. Contact: S. J. Schneider (NBS Inorganic Materials Division).

Symposium on the Application of Computers to Environmental Engineering Design. Nov. 30–Dec. 2. Cosponsor: American Society of Heating, Refrigerating and Air Conditioning Engineers. Contact: R. Achenbach (NBS Building Research Division).

[1] Order by SD Catalog Number from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, for the price indicated.

COOPERATIVE PROGRAM ENGAGES NBS REACTOR

The Bureau and the Picatinny Arsenal have announced a cooperative effort to determine material properties using the facilities at the NBS reactor (NBSR). Neutron diffraction and time-of-flight facilities, established at the reactor, will enable the researchers to study both elastic and inelastic scattering of neutrons from solids and liquids. These scattering techniques will provide data on atomic and molecular structures, molecular binding forces and energy levels, and phase transitions within a solid.

Under the agreement, Drs. Henry Prask, Sam Trevino and C. S. Choi of the Structure and Lattice Dynamics Section of Picatinny's Feltman Research Laboratory will transfer their program and equipment from the Watertown Arsenal near Cambridge, Mass. to the NBSR. The NBS participants in the cooperative program are Drs. J. J. Rush and R. S. Carter of the NBS Reactor Radiation Division. This permanent staff will be augmented by several positions filled on a temporary or rotating basis.

FIPS NOTES

In the fall of 1965 the Secretary of Commerce established the NBS Center for Computer Sciences and Technology to carry out the Secretary's responsibilities under the Brooks Bill (Public Law 89–306, passed October 30, 1965). The Center provides leadership and coordination for government efforts in the development of voluntary commercial information processing standards, develops recommendations for Federal scientific and technical support and consultative assistance in the field of computers and information processing to Federal agencies. These Notes will cover information-processing standards activities in the Federal Government, particularly those of the Center.

STANDARD CODES FOR COUNTRIES, DEPENDENCIES AND AREAS OF SPECIAL SOVEREIGNTY

The Bureau of the Budget has approved—as a Federal Information Processing Standard (FIPS)—standard codes for countries, dependencies and areas of special sovereignty. These codes have been published by NBS as a Federal General Data Standard, Representations and Codes, in Federal Information Processing Standards Publication 10[1] (FIPS PUB 10, 30 cents; SD Catalog No. C13.52:10).

The standard provides a list of basic geographical-political entities and an associated standard code. The entities include: independent states, dependent areas, areas of quasi-independence, non-contiguous territories, possessions without population, areas with special sovereignty associations, areas without sovereignty, political regimes not recognized by the United States, and outlying areas of the United States. The standard code (two alphabetic characters) is for use in the interchange of formatted machine-sensible data among Federal agencies and between these agencies and the public, including industry and State and local governments. The standard is to be implemented on or before January 1, 1971, by Federal departments and agencies.

The standard was developed by a Federal Task Group under the Chairmanship of Bruce H. Allen, Department of State, and was coordinated with Federal agencies in February 1970. In the qualifications section, recognition is given to the fact that many different sets of geographical entities and codes are now used in the Federal Government and that the standard is not intended to be a universal replacement of all of these current practices. Where interchange arrangements exist between systems or between agencies, the standard need not be used if its use causes serious disruption. Also, the standard codes are qualified as "interim" pending the development of standards by the American National Standards Institute (ANSI) and the International Organization for Standardization (ISO). The use of the standard codes in the interim is advised to facilitate information interchange for an unknown period of time, and to allow an orderly conversion to a new code scheme, if necessary.

The names of the countries, dependencies, and areas of special sovereignty along with their standard codes are available also in Hollerith punched cards from the NBS Clearinghouse for Federal Scientific and Technical Information ($3; PB 190 720).[2]

STANDARD CODES FOR STATES AND COUNTIES OF THE STATES OF THE UNITED STATES REVISED

Changes to two Federal General Data Standards have been approved by the Bureau of the Budget. These changes affect FIPS 5, States of the United States, and FIPS 6, Counties of the States of the United States.

Two-character alphabetic abbreviations have been added for the States as an alternative standard representation. Abbreviations are preferred when human considerations and input reliability are important. The numeric code may be used in those applications where machine and numeric sorting considerations are more important. The outlying areas of the United States, in addition to their current two-character numeric codes, have been assigned two-character alphabetic codes from the county code standard (FIPS 10). This was necessitated since some applications treat outlying areas of the U.S. more like countries than "first order subdivisions of the U.S." The revised pub-

lication, entitled *States and Outlying Areas of the United States*, has been redesignated as FIPS PUB 5-1 [1] (20 cents; SD Catalog No. C13. 52:5-1).

The current county code standard (FIPS 6) has been revised and published as FIPS PUB 6-1, *Counties and County Equivalents of the States of the United States* [1] (45 cents; SD Catalog No. C13.52:6-1). The major change is in the State of Alaska where both census divisions and boroughs are considered to be county equivalents. New codes are assigned for these Alaskan equivalents. An outline map and a list of Alaskan places together with standard codes are provided to assist in the implementation of the standard. Other changes have been made in the States of Hawaii, Nevada, New Hampshire, and Virginia.

The names of the States and outlying areas along with their standard abbreviations and codes are available in Hollerith punched cards from the NBS Clearinghouse for Scientific and Technical Information [2] ($3; PB 190 710).

County names and codes and related State abbreviations and codes are available on punched cards from the Clearinghouse [2] ($32; PB 190 605). These codes are also available on magnetic tapes, and are provided in six different recording forms: 7 track, BCD coded, odd or even parity, and 556 and 800 characters per inch; 9 track, ASCII (FIPS 1) or EBCDIC codes recorded at 800 characters per inch. When ordering specify the tape characteristics needed [2] ($25; PB 190 604).

THE HIGH COST OF COMPUTER STANDARDS

At the 51st annual meeting of the American National Standards Institute, C. W. Fritze, Director of Corporate Planning, Control Data Corporation, reported that the costs for developing U.S. computer industry voluntary standards are estimated in a BEMA study to be running at a rate of more than $6 million a year. Of this cost, more than half is contributed by manufacturers. The balance comes from government users, and general interest support.

Most of the cost is attributable to providing representatives to attend standards meetings and associated salaries and travel expenses. The $6 million spent on standards represents about 0.1 percent of the value of computer equipment produced in the U.S. each year. Mr. Fritze pointed out that his company alone spent on the order of $200 000 per year on standards. This figure includes three full-time professional standards experts and 27 other people on 30 different standards committees, which meet six to eight times a year.

He also stated that the risk of nonconformity was high and the cost of product design or redesign to meet standards already established was very high. He stressed that top management must recognize the costs and risks of standardization and attempt to minimize these by early participation and good standards planning.

NBS currently is attempting to identify all government participants who are contributing to the development of standards for computers and information processing. Early estimates place this figure at close to 250 individuals. NBS alone has 14 professional full-time standards experts in the Office of Information Processing Standards and 6 others from different NBS organizations participating in ADP standards work at an annual cost of nearly $850 000.

BEMA NAMES ASSISTANT DIRECTOR OF STANDARDS

Robert M. Brown has been appointed Assistant Director of Standards, Business Equipment Manufacturers Association (BEMA). He will assist the Director, Vico E. Henriques, in providing administrative support and direction to American National Standards Institute Committees X3, Computers and Information Processing, and X4, Office Machines, for which BEMA holds the Secretariats. Mr. Brown joined the BEMA staff upon his retirement from government service in April 1970. Previously, he was the ADP standards coordinator for the Department of Defense in the Air Force Directorate of Data Automation. He has been active in X3 standards activities through his participation on Subcommittee X3.2, Codes and Input-Output, and the Standards Planning and Requiremeets Committee (SPARC).

CURRENT X3 COMMITTEE ACTIVITIES

At its April 1970 meeting, held at NBS, X3 accepted three draft standards for publication and letter ballot. These were: 1600 cpi (characters per inch) Recorded Phase Encoded Magnetic Tape; Unrecorded Magnetic Tape—9 track, ½ inch; and Identification of Individuals for Information Interchange.[3]

The initiation of standards development work on a draft ANS and ISO standard for the composite programming language PL/1 was approved. Also, the relationships between CODASYL (Conference on Data System Languages) and X3.4.4 (the COBOL Standards Committee) were defined.

A revised scope and program of work was approved for Task Group X3.6.6, Standards for Network Oriented Information Systems such as PERT (Program Evaluation and Review Technique) and CPM (Critical Path Method). Also approved was a scope and program of work for X3.4.3, FORTRAN Programming Language, where work is to continue on clarifications to FORTRAN to be included in a revised draft standard.

X3 also approved the U.S. delegation to the plenary meeting of ISO Technical Committee 97, Computers and Information Processing. T. H. Bonn, Director of Standards, Honeywell, was named Chief U.S. Delegate. Government individuals named to the delegation were: H. R. J. Grosch, NBS; Harry S. White, Jr., NBS; and Helmut Thiess, Naval Command Systems Support Activity.

NEW NUMBERS ASSIGNED TO X3 TECHNICAL COMMITTEES

As a result of the recent X3 reorganization,[4] the Standards Steering Committee (SSC), has renumbered the technical committees. The new numbering system provides for the unique identification of each technical committee within various groups and sections. The number is structured in the following manner:

- The first and second characters are always X3.
- The third character specifies the group and section using the following scheme:
  - Hardware Group—Letters A through I
    - Recognition Section—Letter A
    - Physical Media Section—Letter B
  - Software Group—Letters J through R
    - Language Section—Letter J
    - Documentation Section—Letter K
    - Data Representation Section—Letter L
  - Systems Group—Letters S through Z
    - Data Communications Section—Letter S
    - System Technology Section—Letter T
- The subsequent characters, with separators (periods), are used to identify each technical committee within a section. In the renumbering by SSC, current numbers were retained to the extent possible (i.e. X3.8 became X3L8 and X3.8.1 became X3L8.1).

Table 1

HARDWARE		SOFTWARE		SYSTEMS	
New	Old	New	Old	New	Old
X3A1	X3.1	X3J3	X3.4.3	X3S3	X3.3
X3A1.1	X3.1.1	X3J4	X3.4.4	X3S3.3	X3.3.3
X3A1.1A	X3.1.1A	X3J4.1	X3.4.4.1	X3S3.4	X3.3.4
X3A1.2	X3.1.2	X3J4.2	X3.4.4.2	X3S3.5	X3.3.5
X3A1.3	X3.1.3	X3J4.3	X3.4.4.3	X3S3.6	X3.3.6
X3A7	X3.7	X3J4.4	X3.4.4.4		
		X3J7	X3.4.7	X3T9	X3.9
X3B1	X3.2.1	X3J8	X3.4.8		
X3B2	X3.2.2B				
X3B3	X3.2.3A	X3K1	X3.6.8.1		
X3B4	X3.2.2A	X3K2	X3.6.5		
X3B7	X3.2.7	X3K3	X3.6.3		
X3B7A	X3.2.7A				
X3B7B	X3.2.7B	X3K5	X3.5		
X3B7C	X3.2.7C	X3K5.1	X3.5.1		
		X3K5.2	X3.5.2		
		X3K5.3	X3.5.3		
		X3K6	X3.6.6		
		X3L1	X3.2F		
		X3L2	X3.2		
		X3L5	X3.2.5		
		X3L8	X3.8		
		X3L8.1	X3.8.1		
		X3L8.2	X3.8.2		
		X3L8.3	X3.8.3		
		X3L8.4	X3.8.4		
		X3L8.6	X3.8.6		

Table 1 lists both the new and old designations of the X3 Technical Committees.

X3 GROUP DIRECTORS AND SECTION MANAGERS APPOINTED

Charles A. Phillips, Chairman of X3, has made the following appointments of group directors and section managers:

- Hardware Group Director—Charles Navoichick, Control Data Corporation
  - Recognition Section Manager—Bernard Radack, Internal Revenue Service
  - Physical Media Section Manager—Philip S. Johnson, NBS
- Software Group Director—Dennis E. Hamilton, UNIVAC
  - Language Section Manager—(to be named)
  - Documentation Section Manager—C. Roger Shock, Naval Command Systems Support Activity (NAVCOSSACT)
  - Data Representation Section Manager—Thomas O. Holtey, Honeywell
- Systems Group Director—George E. Clark, NBS
  - System Measurement Section Manager—(to be named)
  - System Technology Section Manager—Glenn E. Poorte, RCA

The group directors and section managers constitute the X3 Standards Steering Committee (SSC), which is chaired by Eric H. Clamons, General Electric. E. D. Spina, IBM, is the SSC vice chairman and Leonard H. Sichel, Jr., is the SSC secretary.

[1] Order by SD Catalog No. from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, for the price indicated.

[2] Order by PB No. from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Va. 22151, for the price indicated.

[3] See **Proposed standard for identification of individuals for information interchange**, FIPS Notes, Nat. Bur. Stand. (U.S.), Tech. News Bull. **54**, No. 6, 133–135 (June 1970).

[4] See, **Reorganization of ANSI Standards Committee X3**, FIPS Notes, Nat. Bur. Stand. (U.S.), Tech. News Bull. **54**, No. 5, 100–102 (May 1970).

NSRDS NEWS

The NSRDS was established to make critically evaluated data in the physical sciences available to science and technology on a national basis. The NSRDS is administered and coordinated by the NBS Office of Standard Reference Data.

JILA INFORMATION ANALYSIS CENTER'S COMPUTER EXPERIENCE

The Information Analysis Center of the Joint Institute for Laboratory Astrophysics (JILA), Boulder, Colo., collects and critically evaluates low-energy electron-collision cross-section data, photoionization and absorption cross-section data, and electron transport data. During the 8 years it has been in operation, it has progressed from a punch card and filing card system to a computer system involving magnetic tape storage of information and cathode-ray-tube preparation of graphical data displays. L. J. Kieffer, Director of the JILA Information Analysis Center has provided the following summary of the Center's experience in using computers that may be instructive to other data and information centers.

The JILA Center's data collection is rather small (about 4000 citations in our bibliographies), with the present input averaging about 40 citations and 1500 data points per month. A data point consists of two numbers suitable for two-dimensional graphical display. At present, our total collection of data points numbers about 150 000.

Before devising any computer system for handling information and data, it is very important to have goals and objectives well defined. Open ended or changing goals make it almost impossible to implement and maintain a computer based system. A very interesting letter identifying changes in objectives, improvements in software, and constant upgrading of computer hardware as reasons for the failure of some large data base systems was published in *Physics Today*, October 1966, by H. R. J. Grosch, NBS. These problems are serious even for small systems such as ours. Because we are a small user, we are dependent upon a central computing facility where changes in software and hardware are beyond our control. Major hardware changes come about every 2 to 3 years while software and peripheral equipment changes occur more frequently. This time scale makes it imperative that accommodation to hardware changes take place in a few months, while accommodation to software and other changes must be made in correspondingly less time.

Our first attempt at a computer based system involved describing each paper on atomic collision physics by its usual citation and a list of descriptive words assigned by a scientist who had scanned or read the paper. The dictionary of descriptor words, of course, was open ended. We intended then to use the computer to prepare bibliographies by searching the tapes and selecting papers with the proper combinations of descriptor words. After several months were invested in preparing programs to accomplish this task, we were presented with our first hardware change. In addition, the new machine being installed was only to operate for about a year before another machine was to take its place. This "changing hardware" problem forced us to completely revise our goals and use the computer in a very simple way.

We decided to do all categorization off line and only keep and classify papers that reported measurements or calculations of collision properties of specific atomic and molecular species. Our dictionary of descriptors was small, finite and closed. The two kinds of data we would collect were cross sections and rate coefficients. The next level of classification was the type of reaction and finally the species taking part. Once a paper was classified according to this scheme, no computer searching was necessary. The information for preparing an annotated bibliography could then be stored on magnetic tape in the order we wished to print them. The order of the reactions and atomic species in this list of course is arbitrary but we chose what seemed to be a reasonable convention. Our basic use of the computer then is automatic composition of bibliographies and data compilations for publication. In addition, of course, the computer has extreme accuracy and speed over hand composition, two very important qualities for a data base system where updating is important.

I would certainly not want to suggest that the way we have chosen our goals and then built the computer system to serve them is adequate for all

centers. I do want to emphasize though that one pays a very dear price for using the computer in a more sophisticated way and it may be a price you cannot afford if you wish to accomplish your goals within a finite budget. Our experience indicates that it takes us about six months to adapt our programs when a major hardware change takes place. It is important to keep programs as simple as possible, otherwise the time required to adapt them becomes comparable to the lifetime of the hardware and the system breaks down. This criterion is extremely important when deciding on the feasibility of any proposed system. Time to get a new system operating can of course be somewhat longer but should probably not exceed a year.

The newest system we have implemented is one which produces graphical displays of our data using a cathode ray tube to photocompose the displays. About two years ago we became aware that the computing facility available to us (ESSA-Boulder Laboratories) was planning to install a Computer Output Microfilm (COM) device. We were in the early stages of planning our system for compiling, storing, and preparing data for publication. As all of our data output essentially would be graphical displays (our present collection contains about 1500 graphs) and we wished to update these graphs frequently, microfilm output was attractive. After some consideration we decided that the speed and cost of this system were important factors in its favor. The plotting accuracy, 0.1 percent of full scale, was quite adequate for our needs. In addition, the 128 character set available, including upper and lower case, Greek letters, and other special symbols, made it possible to prepare "camera ready" graphs for publication. Our experience had been that mechanical plotters were too slow and costly and required considerable hand work to get adequate camera ready graphs.

After installation of the COM device, it took us about a year to obtain what we regarded as adequate graphical displays. Since then the quality of these displays has improved considerably. At the present time it costs on the average $1.30 to obtain a 35-mm microfilm frame of a graphical display. This includes all computer charges. A glossy print of the microfilm for manuscript preparation can be obtained for $1. The combination of speed, accuracy, and cost makes this system extremely attractive. We have computed some other average costs which may be of interest: 60 cents to write a bibliographic citation on our magnetic tapes, and 85 cents to write a data set that, on the average, consists of 50 data points. The cost of writing, maintaining, and improving programs is a major cost. During the past five years we have had 2.5 man-years of programming devoted to our system.

KINETIC DATA ON GAS PHASE UNIMOLECULAR REACTIONS

NSRDS-NBS-21, *Kinetic Data on Gas Phase Unimolecular Reactions* [1] ($7, SD Catalog No. C13.48:21), by Sidney W. Benson, Stanford Research Institute, and H. Edward O'Neal, San Diego State College, is the most recent critical compilation in the NSRDS series.

This collection of chemical rate data has the following purpose:

a. To provide in a convenient format a listing and referencing of all available reaction rate data for first-order, unimolecular, homogeneous, gas phase reactions.

b. To provide insofar as possible a critical evaluation of the reported kinetic parameters for each reaction.

c. To compile rate constants and Arrhenius parameters for each reaction and provide as much additional information as may be necessary for the reader to make an independent decision regarding the validity of the reported data.

d. To provide a primary rate data collection to which future kinetic results pertinent to unimolecular, homogeneous gas phase reactions may be conveniently added.

e. To indicate those areas in which theories of kinetics and existing rate data are nonconcordant, and by so doing provide a background with which future experimental investigations may be both planned and compared.

The authors' aim has been to review all available rate data on thermally induced unimolecular, homogeneous, gas phase reactions of molecules and free radicals, and to present as comprehensive a collection of these data as possible. Literature through December 31, 1966, has been reviewed. Reactions of special interest appearing in print between January 1, 1967, and February 1, 1968, have also been included.

This compilation has been limited to the reaction kinetics of thermally equilibrated molecules and free radicals. Ionic species have not been included. Also absent are the reaction kinetics of vibrationally and/or electronically energetic reactive intermediates produced photochemically, by chemical activation, or by high-energy radiation. "Unimolecular" reactions that are not first-order (i.e., those in their low-pressure or pressure-dependent regions) have been reviewed only in those cases where extrapolations or calculations were made to provide estimates of the limiting high-pressure first-order rate constants.

In general each reaction is listed on a separate data sheet. Exceptions to this rule are those reactions that have been studied collectively under identical experimental conditions for correlation purposes.

Molecular reactions are classified in one of four reaction types: a. Molecular eliminations (or complex fissions); b. Isomerizations of noncyclic compounds; c. Cyclic compound reactions; and d. Simple bond fissions.

Free radical reactions are treated as a fifth and separate group. Within each of the four major categories, reactions are subgrouped according to mechanistic and structural similarities. This offers the reader the distinct

advantage of being able to rapidly scan the results for many reactions of the same kind. Reactions have been indexed alphabetically in terms of the reactants. A section index lists the categories and subgroups into which each reactant molecule has been filed.

Preferred values are those judged to be most consistent with the experimental reaction rate and transition state theory. In some instances, where experimental errors are believed to be large enough to accommodate changes in the reported Arrhenius parameters, preferred values are those estimated from transition state calculations. Results of transition state calculations are given for the purpose of comparison with the experimental values. Reactions reported to be unimolecular, but judged by the reviewers as questionable, have been cited as either *suspect* or *unreliable*. In all cases, under "Comments" the reasons for having made these evaluations are given and, where possible, other possibly more reasonable interpretations are suggested.

References to each experimental study are numbered and listed on the same line as the Arrhenius parameters of that study.

ELECTRONIC-EXCITATION CROSS-SECTIONS

The second part of a three-part compilation [2] entitled *Low-Energy Electron-Collision Cross-Section Data: Electronic-Excitation Cross-Sections* prepared at the JILA Information Analysis Center (Boulder, Colo.) has been published in *Atomic Data*, Vol. I, No. 2, Nov. 1969. This compilation, authored by L. J. Kieffer, presents in graphs and tables selected experimental data on cross-sections for electronic excitation of some 20 atomic and molecular targets important in aeronomy, astrophysics, and plasma physics. Values for both level and line excitation are given as functions of energy of the impacting electron. Criteria used for data selection by the author are discussed. The data included were taken from the literature through December 1968. A bibliography and author index are also included.

BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF MATERIALS

The latest in a series of current-awareness bibliographies on high-temperature chemistry and physics published under the auspices of the Commission on High Temperature and Refractories of the International Union of Pure and Applied Chemistry (IUPAC) has been published as National Bureau of Standards Special Publication 315–4 [1] (75 cents; SD Catalog No. C13.10:315–4). This issue covers the period October–December 1969. Material for the bibliography is gathered by scientists attached to the Commission. Part I, on Solids and Liquids, is compiled by members of the Working Group scanning the pertinent journals published in their countries and, in some cases, in adjacent countries, while the literature of the other countries is covered by the editor, J. J. Diamond. Part II, on Gases, is obtained by searching *Chemical Abstracts*. All titles are translated into English.

[1] Order by SD Catalog number from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, for the price indicated.

[2] Part I of this compilation, Low-Energy Electron-Collision Cross-Section Data: Ionization, Dissociation, Vibrational Excitation, Atomic Data I, No. 1, Sept. 1969.

STANDARDS AND CALIBRATION

STANDARD FREQUENCY AND TIME BROADCASTS

High-frequency radio stations WWV (Fort Collins, Colo.) and WWVH (Maui, Hawaii) broadcast time signals on the Coordinated Universal Time (UTC) system as coordinated by the Bureau International de l'Heure (BIH), Paris, France. The NBS time scale, UTC(NBS) and the U.S. Naval Observatory time scale, UTC(USNO) are jointly coordinated to within ± 5 microseconds. The UTC pulses occur at intervals that are longer than one coordinate second by 300 parts in 10^{10} during 1970, due to an offset in carrier frequency coordinated by BIH. To maintain the UTC scales in close agreement with the astronomers' time, UT2, phase adjustments are made at 0000 hours Greenwich Mean Time (GMT) on the first day of a month as announced by BIH. *There will be no adjustment made on August 1, 1970.*

The low-frequency radio station WWVB (Fort Collins, Colo.) broadcasts seconds pulses without offset to make available to users the standard of frequency so that absolute frequency comparisons may be made directly, following the Stepped Atomic Time (SAT) system. Step time adjustments of 200 ms are made at 0000 hours GMT on the first day of a month when necessary. BIH announces when such adjustments should be made in the scale to maintain the seconds pulses within about 100 ms of UT2. *There will be no adjustment made on August 1, 1970.*

NBS obtains daily UT2 information from forecasts of extrapolated UT2 clock readings provided by the U.S. Naval Observatory with whom NBS maintains close cooperation.

PUBLICATIONS of the National Bureau of Standards*

PERIODICALS

Technical News Bulletin, Annual Subscription: Domestic, $3; foreign, $4. Single copy price 30 cents. Available on a 1-, 2-, or 3-year subscription basis. SD Catalog No. C13.13:54.

Journal of Research of the National Bureau of Standards

Section A. Physics and Chemistry. Issued six times a year. Annual subscription: Domestic, $9.50; foreign, $11.75. Single copy price varies. SD Catalog No. C13.22/sec.A:74.

Section B. Mathematical Sciences. Issued quarterly. Annual subscription: Domestic, $5; foreign, $6.25. Single copy, $1.25. SD Catalog No. C13.22/sec.B:74.

Section C. Engineering and Instrumentation. Issued quarterly. Annual subscription: Domestic, $5; foreign, $6.25. Single copy, $1.25. SD Catalog No. C13.22/sec.C:74.

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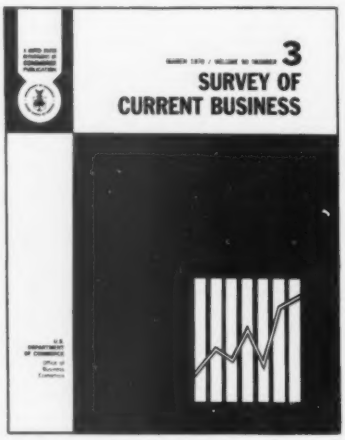

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